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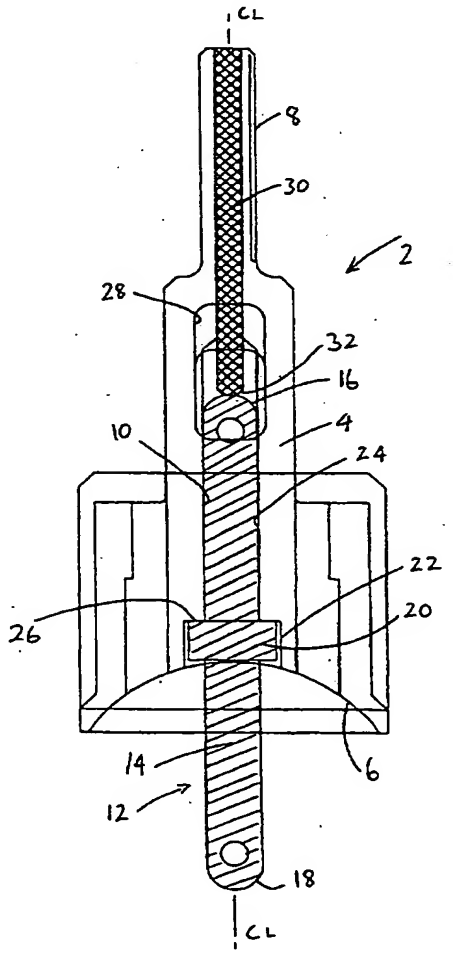
(54) Abstract Title
Rotary mill

(57) A rotary mill (2) comprises a body portion (4) having at a first end a milling surface (6) and at a second end, opposite to the first end, means for connection to a rotating drive device (8). A central bore (10) is formed through the body portion (4) along a rotary axis of the body portion (4), which axis (CL) extends from the first end to the second end of the body portion (4). The rotary mill also comprising a guide rod (12) which is free to slide along and rotate in the bore (10), the guide rod (12) having a depth stop (20) which engages a corresponding formation (26) on the body portion (4) to limit the milling depth of the rotary mill (2).

Preferably, the body portion (4) is adapted so that a portion of the guide rod (12) which is inserted in the bore (10) may be viewed by an observer as the depth stop (20) approaches the corresponding formation (26) on the body portion (4).

The rotary mill may be used to cut away bone, eg the femur, prior to the implanting of a prosthetic joint.



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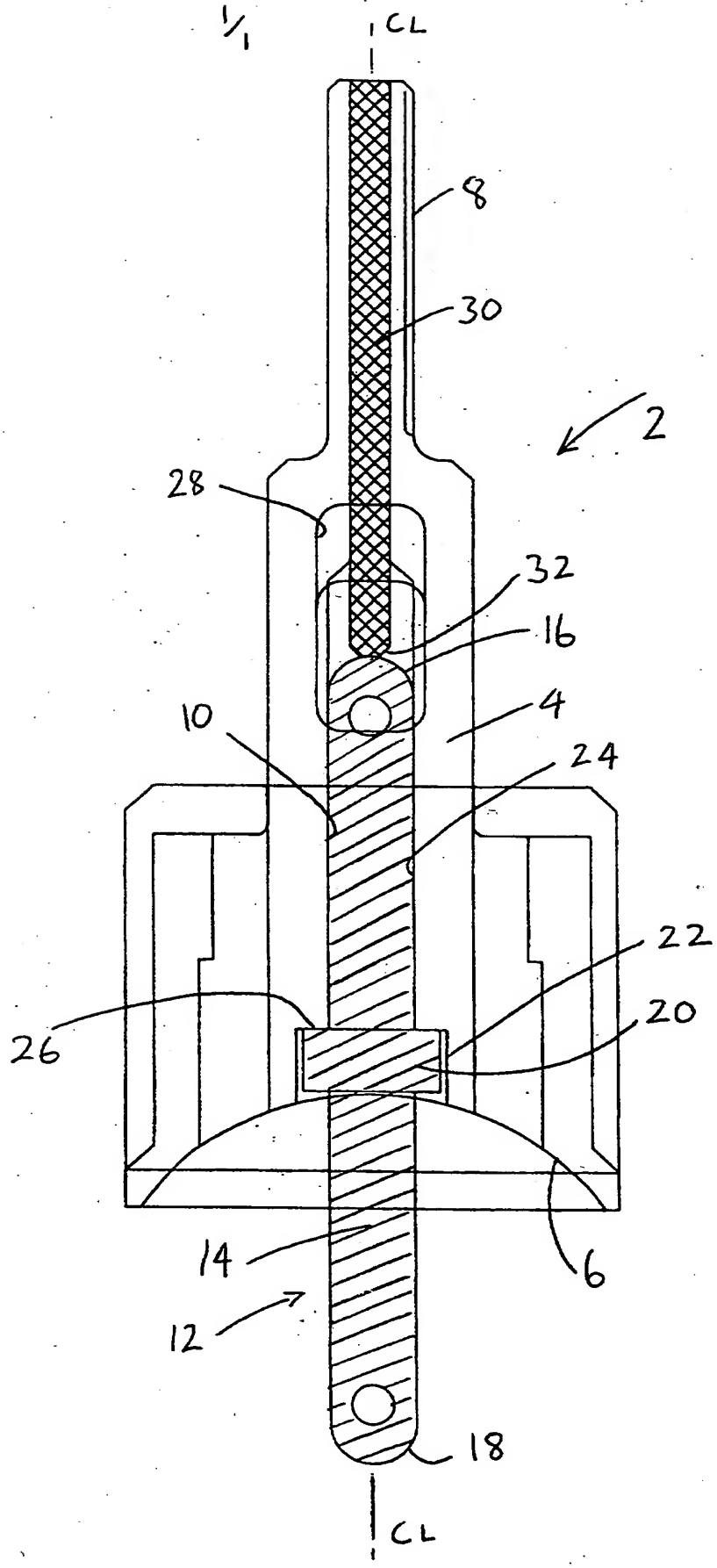

ROTARY MILL

This invention relates to rotary mills or other rotary cutters and particularly, although not exclusively, relates to rotary mills which are used to cut away bone prior to the implanting of a prosthetic joint.

BACKGROUND TO THE INVENTION

In osteoarthritis, the disease process usually starts in one of the tibio-femoral compartments and may spread to involve the other at a later stage in its development. Experience has shown that total replacement of one compartment is all that is needed to provide prolonged relief from symptoms.

The design requirements for such unicompartmental knee replacement are more demanding than those for a total condylar anthroplasty. In the latter procedure the mechanics of the knee can be simplified, for instance, by discarding one or both of the cruciate ligaments. If necessary, re-alignment of the limb can be accomplished with impunity by detaching one or other colateral ligaments, because the implant has some inherent stability.

In unicompartmental anthroplasty there is no such freedom. All the ligaments of the joint must be retained and restored to their natural tensions and the bearing components themselves must be completely unrestrained. This means that the artificial articular surfaces must have no preferred axis of movement of their own but must be able to accommodate the patterns of movement which the natural ligamentous apparatus ordains. Conventionally, a unicompartmental femoral component is attached to the human femur after a series

of planar cuts have been made through the femur with a bone saw, or chisel. Accurate alignment of these cuts is vital for a successful patient outcome. In order to improve the accuracy of the cuts made on the femoral component, a rotary mill was devised which rotated about an axis coincident with a central arbur or guide rod which was fixed in an axial direction relative to the mill. In use of the rotary mill, a hole was drilled into the femur to a pre-determined depth, the guide rod was inserted into the hole in the femur and the mill rotated by means of a surgical power tool to mill away bone until the end of the guide rod abutted the end of the hole in the femur. This technique was generally very successful, but sometimes it was necessary to mill away a larger amount of bone. In such circumstances, it was necessary to undo a grub screw which retained the guide rod relative to the rotary mill, slide the guide rod relative to the mill and then re-tighten the grub screw, before repeating the procedure. This procedure was time consuming and required considerable skill from the surgeon to achieve the required accuracy of cut.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention, there is provided a rotary mill comprising a body portion having at a first end a milling surface and, at a second end opposite to the first end, means for connection to a rotating drive device, a central bore being formed through the body portion along a rotary axis of the body portion, which axis extends from the first end to the second end of the body portion, and a guide rod which is free to slide along the bore, the guide rod having a depth stop which engages a corresponding formation on the body portion to limit

the milling depth of the rotary mill.

According to a second aspect of the present invention, there is provided a rotary mill comprising a body portion having at a first end a milling surface and, at a second end opposite to the first end, means for connection to a rotating drive device, a central bore being formed through the body portion along a rotary axis of the body portion, which axis extends from the first end to the second end of the body portion, and a guide rod which is free to slide along the bore, the body portion being adapted so that a portion of the guide rod which is inserted in the bore may be viewed by an observer as it travels along the bore.

Preferably the depth stop comprises an annular projection which is connected to the guide rod at an intermediate position along its length. Most preferably, the annular projection is integrally formed on the guide rod and/or is situated approximately half way along the length of the guide rod.

The said corresponding formation may comprise the mouth of the said bore. Preferably, however, the said corresponding formation comprises a shoulder formed at the transition between a larger diameter portion of the bore and a smaller diameter portion of the bore.

Preferably the body portion is adapted so that a portion of the guide rod which is inserted in the bore may be viewed by an observer as the depth stop approaches the corresponding formation on the body portion. Preferably a recess is formed in a side wall of the body portion, which recess extends into the bore so that the end of the guide rod may be viewed. The recess may comprise an opening which intersects the

bore and which extends through the full width of the body portion. In this way, the end of the guide rod can be viewed through the opening from either side of the body portion.

Preferably an indicator abutment is provided in the second end of the body portion, the indicator abutment abutting the end of the guide rod when it reaches the limit of travel in the bore. Preferably the indicator abutment can be viewed through the recess or opening formed in the body portion, so that the point at which the end of the guide rod abuts the indicator abutment can be determined visually by an observer looking through the recess or opening.

Preferably the indicator abutment comprises the said corresponding formation on the body portion.

Preferably the rotary mill further comprises additional guide rods of different lengths, the depth of cut of the rotary mill being determined by selecting an appropriate one of the said guide rods.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention and to show how it may be carried into effect, reference will now be made, by way of example to the accompanying drawing which is a cut away side view of a rotary mill in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

Referring to the drawing, a rotary mill 2 comprises a body portion 4, having at a first end a rotary milling

surface 6 and at a second end opposite to the first end having an integral shank 8 for attachment to the chuck of a surgical drill (not shown). A bore 10 is formed through the body portion 4 along a longitudinal axis CL of the body portion 4. A guide rod 12 is slidably and rotatably received within the bore 10.

The guide rod 12 comprises an elongate cylindrical arbour 14 having rounded ends 16, 18. An annular projection 20 is integrally formed with the arbour 14 at an intermediate position along its length.

The bore 10 in the body portion 4 comprises a first larger diameter portion 22 which forms the mouth of the bore 10 and a smaller diameter portion 24 which is sized to closely receive the arbour 14 of the guide rod 12. The transition between the larger diameter portion 22 and smaller diameter portion 24 of the bore 10 defines a substantially radially disposed shoulder 26 against which the annular projection 20 of the guide rod 12 abuts when the guide rod 12 is at its limit position within the body portion 4. Thus the annular projection 20 acts as the depth stop of the guide rod 12.

An opening or "window" 28 is formed in the second end of the body portion 4, the opening 28 intersects the bore 10 and therefore provides a window through which the second end 16 of the guide rod 12 can be viewed, when the guide rod 12 is in, or is close to, its limit position.

A visual indicator rod 30 is fixed within the hollow core of the shank 8, and at the limit position of the guide rod 12 a first end 32 of the indicator rod abuts the second end 16 of the guide rod 12.

In use of the rotary mill, a bore is drilled to a predetermined depth in the femur of a patient (not shown). The first end 18 of the guide rod 12 is then inserted into the hole until the first end 18 abuts the bottom of the hole. With the guide rod 12 located in the femur, the body portion 4 of the rotary mill is slid over the second end 16 of the guide rod 12, so that the arbour 14 of the guide rod 12 slides freely into the bore 10. A surgical power tool (not shown) is attached to the shank 8 of the rotary mill and is then operated to rotate the rotary mill about the guide rod 12. The rotating body portion 4 is slid down the arbour 14, until the rotary milling surface 6 engages the femur. Further downward pressure on the surgical power tool causes the rotary mill to cut away a portion of the femur until the annular projection 20 abuts the shoulder 26 formed in the body portion 4 and thereby prevents further downward movement of the body portion 4. The body portion 4 is then withdrawn from the guide rod 12 and the milling depth inspected.

As mentioned above, the point at which the annular projection 20 abuts the shoulder 26 is set to coincide with the point at which the second end of the guide rod 12 abuts the visual indicator rod 30. Thus a surgeon is able to observe how the cutting operation is progressing by observing, through the window 28, the gradual approach of the second end 16 of the guide rod towards the visual indicator rod 30. In addition to providing a visual indication of how the cutting operation is progressing, the window 28 enables the surgeon to determine the exact position at which the cutting operation should be stopped. Without a window 28, the surgeon must rely on the increased resistance to downward movement of the surgical power tool which occurs when the annular projection 20 abuts the

shoulder 26. If the bone is soft at the bottom of the guide hole which is initially drilled in the femur, there is a risk that the guide rod 12 might be forced further into the femur when the annular projection 20 abuts the shoulder 26. In such circumstances, an excessive amount of bone would be milled away by the rotary mill. This problem is prevented by the provision of the window 28.

If normal anatomical movement of the knee can only be restored by milling away a further portion of the femur, the guide rod 12 is removed from the hole in the femur and another guide rod (not shown) is selected from a set of such guide rods 12. The replacement guide rod has a shorter distance between the first end 18 and the annular projection 20. The body portion 4 is then slid back onto the new guide rod and further milling commences for a depth equal to the difference in length between the new guide rod and the guide rod 12 which it replaces.

It is envisaged that the guide rods will be provided as a set of, for example, 6 guide rods which are of the same length from the annular projection 20 to the second end 16, but which are progressively shorter in length from the annular projection 20 to the first end 18 of the guide rod 12. The difference in length between successive guide rods in a set is preferably one millimetre.

It will be appreciated that, by selecting the appropriate guide rod, the correct milling depth is easily achieved. Ideally, the surgeon would choose the correct length of guide rod first time, but it would be preferable to select a slightly longer guide rod for the first cut and then select a shorter guide rod for a

subsequent cut, if it proved necessary. This approach avoids the risk of milling too deeply at the outset.

CLAIMS

1. A rotary mill comprising a body portion having at a first end a milling surface and at a second end, opposite to the first end, means for connection to a rotating drive device, a central bore being formed through the body portion along a rotary axis of the body portion, which axis extends from the first end to the second end of the body portion, and a guide rod which is free to slide along the bore, the guide rod having a depth stop which engages a corresponding formation on the body portion to limit the milling depth of the rotary mill.

2. A rotary mill as claimed in claim 1, in which the depth stop comprises an annular projection which is connected to the guide rod at an intermediate position along its length.

3. A rotary mill as claimed in claim 2, in which the depth stop is integrally formed with the guide rod.

4. A rotary mill as claimed in any one of the preceding claims, in which the said corresponding formation comprises the mouth of the said bore.

5. A rotary mill as claimed in any one of claims 1 to 4, in which the said corresponding formation comprises a shoulder formed at the transition between a larger diameter portion of the bore and a smaller diameter portion of the bore.

6. A rotary mill as claimed in any one of the preceding claims in which the body portion is

adapted, so that a portion of the guide rod which is inserted in the bore may be viewed by an observer as the depth stop approaches the corresponding formation on the body portion.

7. A rotary mill as claimed in claim 6, in which a recess is formed in a side wall of the body portion, which recess extends into the bore so that the end of the guide rod may be viewed.

8. A rotary mill as claimed in claim 7, in which the recess comprises an opening which intersects the bore and which extends through the full width of the body portion, through which opening the end of the guide rod can be viewed.

9. A rotary mill as claimed in claims 7 or 8, in which an indicator abutment is provided in the second end of the body portion, the indicator abutment abutting the end of the guide rod when it reaches the limit of travel in the bore.

10. A rotary mill as claimed in claim 9, in which the indicator abutment can be viewed through the recess or opening formed in the body portion.

11. A rotary mill as claimed in claim 10, in which the indicator abutment comprises the said corresponding formation on the body portion.

12. A rotary mill as claimed in any one of the preceding claims further comprising additional guide rods each of a different length, the milling depth of the rotary mill being determined by selecting an appropriate one of the said guide rods.

13. A rotary mill substantially as described herein, with reference to and as shown in the accompanying drawings.

Application No:	GB 0002301.0	**Examiner:**	Gareth Prothero
Claims searched:	1 to 13	**Date of search:**	10 July 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): B3C C1B6E, C1B8G; B5L LTX

Int Cl (Ed.7): A61B 17/16

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 1500360 A (FRIEDRICHSFELD) see whole document.	1 to 4 & 6 to 8

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

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